This invention relates to cables for transmitting high frequency electric signals. The invention is particularly directed to the provision of an improved cable of so-called semi-solid construction, in which a pair of metallic conductors are maintained in spaced parallel relation by a supporting structure of dielectric material which is contrived so as to provide substantial air spaces between the conductors, and between each conductor and the outer surface of the cable.

The common type of cable for transmitting high frequency signals, and which has heretofore been used extensively for television lead-in service, is of flat parallel construction comprising two metallic conductors embedded in the edges of a ribbon of polyethylene. While such cable is simple to manufacture and is well suited for use at the frequencies heretofore customarily employed in television transmission, it is not well suited for use at higher frequencies. One objection to the flat parallel cable for UHF (ultra high frequency) service is that for a cable of given spacing between conductors, the capacitive coupling between conductors is appreciable, because even with polyethylene (one of the best high frequency dielectrics known) the dielectric constant of the material interposed between the conductors is substantial. A further disadvantage of the flat parallel construction is that when it is used out-of-doors and becomes wetted or otherwise coated with an electrically conducting or semi-conducting film, the capacitive coupling between conductors through such film, and the capacitive coupling of each conductor to ground (the conducting film is almost

invariably grounded) is enormously increased.

The present invention provides an improved cable construction in which a minimum capacitive coupling between the conductors, for a cable of given size, is affected by the provision of a substantial air space in the cable supporting structure midway between the metallic conductors. At the same time, the design of the new cable minimizes such increase in the capacitive coupling between conductors, or between either conductor and ground, as occurs through the accumulation of a conducting or semi-conducting film of foreign matter on the outer surface of the cable.

A cable according to this invention comprises a pair of metallic conductors, each wrapped with a thread of dielectric material applied in the form of a long pitch helix, and a supporting structure of dielectric material maintaining said thread-wrapped conductors in spaced parallel relation. It is characteristic of the invention that the supporting structure includes a centrally disposed substantially tubular component between the conductors, which provides a substantial air space midway between them. Such tubular component insures a maximum of air spacing between the conductors. It may comprise a tube of dielectric material which is formed separately from a surrounding jacket which supports the conductors in their proper spaced relation to one another, or it may be formed integrally with the cable jacket.

Advantageous cable designs embodying the foregoing and other features of the invention are shown in the accompanying drawings, in which

Figure 1 shows a cable in which the tubular component between conductors is formed separately from the cable jacket;

Figure 2 shows a cable according to the invention in which the tubular component between conductors is formed integrally with the cable jacket; and

Figure 3 shows a modified form of cable in which the tubular component between conductors is formed integrally with the cable jacket, and in which an increased degree of air spacing between conductors and between each conductor and the cable jacket is achieved.

The cable shown in Figure 1 comprises a pair of metallic conductors 5, each of which is wrapped with a thread 6 of polyethylene or other dielectric material having good high frequency properties, applied in the form of a long pitch helix. A tube 7 of polyethylene or other dielectric material having good high frequency properties is disposed between the thread-wrapped conductors 5, and serves to hold them spaced apart by a distance corresponding to the outside diameter of the tube plus twice the diameter of the threads 6. A jacket 8 of dielectric material, advantageously also of polyethylene composition, surrounds both the thread-wrapped conductors and the tube 7, and serves to hold the components of the cable in proper relation with one another.

The tube 7, with its open central passage 9, assures that a minimum of solid dielectric material and a maximum of air (at least to the extent consistent with a cable construction of mechanically strong design) is interposed between the metallic conductors 5. Accordingly the

capacitive coupling between conductors, for a cable of given cross-sectional dimensions, is minimized. Also, the thread wrappings 6 insure that the conductors 5 are held in spaced relation with the jacket 8, thus providing for a substantial measure of air spacing between each conductor and the jacket. Consequently if the outer surface of the jacket becomes coated with moisture, salt spray, or other conducting or semi-conducting film, on account of exposure to the weather or on account of use in contaminated atmospheres, the effect of such coating of increasing the capacitive coupling between conductors, or of either conductor to ground, is minimized.

The forms of cable shown in Figures 2 and 3 differ from that shown in Figure 1 in that the tubular component interposed between the conductors is formed integrally with the cable jacket to provide a unitary supporting structure for the conductors.

The cable shown in Figure 2 comprises a pair of metallic conductors 10, each of which is wrapped with a thread 11 of polyethylene or other dielectric material having good high frequency properties. These thread-wrapped conductors are maintained in proper spaced relation throughout the length of the cable by a supporting structure 12 of dielectric material, advantageously also a polyethylene composition. The supporting structure 12 is formed with a central tubular passage 13 which extends longitudinally throughout the length of the cable. Flanking the tubular passage 13 is a pair of channels 14, one on each side thereof, which also extends throughout the length of the cable. The thread-wrapped conductors 10 are positioned in

these channels, and are supported axially therein by the helically wrapped threads 11.

The dielectric material of the supporting structure 12, which forms the walls of the passage 13 constitutes a tubular component interposed between the thread-wrapped conductors 10; and the dielectric material adjacent the surface of the supporting structure 12 constitutes a cable jacket joined integrally with such tubular component. Thus the cable of Figure 2 differs from that of Figure 1 simply in that the tubular component and the jacket are formed integrally rather than as separate elements. It is, of course, apparent that the cable of Figure 2, like that of Figure 1, provides a maximum of air spacing, in a cable of given cross-sectional dimensions, between the spaced pair of conductors 10. Also, the thread wrappings 11 insure that a substantial air spacing separates each conductor 10 from the dielectric material which forms the outer surface (jacket or jacket portion) of the supporting structure.

The form of cable shown in Figure 3 comprises a pair of metallic conductors 15, each of which is wrapped with a thread 16 of polyethylene or other dielectric material having good high frequency properties. These thread-wrapped conductors are supported in spaced relation by a hollow supporting structure 17 of oval cross-section. The supporting structure is formed with a group of four interiorly projecting and substantial centrally disposed ribs 18. These ribs diverge from one another so as to form a central substantially tubular passage 19 which extends throughout the length of the cable. The thread-

wrapped conductors 15 are supported on the ribs 18, on either side of the tubular passage 19. Interiorly projecting positioning ribs 20, which are formed integrally with the supporting structure 17 at its side edges, serve to hold the thread-wrapped conductors 15 against the ribs 18. The outer marginal portion 21 of the supporting structure 17 constitutes a cable jacket which encloses and protects the conductors disposed within it.

The substantially tubular passage 19 forms a substantial air space midway between the conductors 15, and so minimize the capacitive coupling between conductors.

A feature of the cable of Figure 3 is that channels 22 are formed between the centrally disposed supporting ribs 18 and the laterally projecting positioning ribs 20; and these channels provide substantial air spaces, additional to that provided by the helical wrapping of thread 16, separating the conductors 15 from the jacket portion 21 of the cable supporting structure 17. As a result, the cable structure of Figure 3 is particularly effectively protected against adventitious capacitive coupling of the conductors with each other, or with ground, by the accumulation of a conducting or semi-conducting film on the outer surface of the jacket. This advantage is attained, however, only at the expense of slightly less secure mechanical supporting of the conductors 15 in their spaced relation to one another.

Each of the various designs of cable discussed above and shown in the drawings has advantages and disadvantages relative to the other designs shown. For example, the cable of Figure 1 is simple to manufacture by

extrusion of the outer jacket 8 about the inner components, but it requires manufacture of the central tubular component 7 independently of the jacket. The cable of Figure 2 can be manufactured by an extrusion operation with a minimum of pre-assembly operations, and is of exceptional rugged mechanical design. It requires, however, a more complex extrusion die than does the cable of Figure 1. The cable of Figure 3 can likewise be made with a minimum of manufacturing operations, and has outstanding properties as a transmission line for high frequency use out-of-doors because of the large amount of air spacing between conductors, and between each conductor and the outer jacket 21. Mechanically, however, the cable structure of Figure 3 is less rugged than that of Figure 2, at least in so far as concerns securely maintaining the conductors 15 in correctly spaced relation to one another when the cable is bent sharply or is otherwise deformed.

It is apparent that all of the various cable forms discussed above possess in common the advantages of a maximum of air spacing between conductors that is consistent with good mechanical support for the conductors in correct spaced relation to one another. Also each of the above cable designs embodies sufficient air spacing between each conductor and the outer surface of the jacket so that when a cable of any of these designs and of modest cross-sectional dimensions is used out-of-doors or in damp locations its utility as a transmission line for UHF signals is not destroyed by the accumulation of a grounded conducting or semi-conducting film on its outer surface.

It is, of course, important to exclude moisture

and other contaminants from the various passages and channels provided in the cable structures discussed above. For this reason, at cable terminations and splices, and especially where such occur out-of-doors, it is important that the ends of the cable be sealed. Any of the techniques heretofore proposed for sealing the ends of semi-solid cables may be adapted to sealing cables of the character herein described.

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The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A cable suitable for conducting high frequency electric signals comprising a pair of metallic conductors each wrapped with a thread of dielectric material applied in the form of a long-pitch helix, and a supporting structure of dielectric material maintaining said thread-wrapped conductors in spaced parallel relation, said supporting structure forming a jacket enclosing the conductors and a centrally disposed substantially tubular component disposed between the conductors and providing a substantial air space midway between them.

2. A cable for conducting high frequency electric signals comprising a pair of metallic conductors each wrapped with a thread of dielectric material applied in the form of a long-pitch helix, a substantially tubular element of dielectric material positioned between said thread-wrapped conductors and maintaining them in spaced-apart relation with a substantial air space midway between them, and a jacket of dielectric material enclosing and supporting the conductors in said spaced-apart relation.

3. A cable for conducting high frequency electric signals comprising a pair of metallic conductors each wrapped with a polyethylene thread applied in the form of a long-pitch helix, a polyethylene tube disposed between said thread-wrapped conductors and maintaining them in spaced-apart relation with a substantial air space midway between them, and a jacket of dielectric material

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surrounding said thread-wrapped conductors and said tube and supporting the conductors against the tube.

4. A cable for conducting high frequency electric signals comprising an elongated supporting structure of dielectric material having a centrally disposed substantially tubular component and further having a pair of channels extending throughout its length one on each side of said tubular component, a metallic conductor positioned in each such channel, and a thread of dielectric material wrapped in the form of a long-pitch helix about each conductor, said conductors being held in spaced relation with said supporting structure by said helical thread wrapping, and said tubular component forming a substantial air space midway between the conductors.

5. A cable for conducting high frequency electric signals comprising an elongated supporting structure of polyethylene formed with a centrally disposed longitudinally extending tubular passage and with a pair of longitudinally extending channels disposed one on each side of said central tubular passage, a conductor positioned in each of said channels, and a polyethylene thread wrapped in the form of a long-pitch helix about each conductor, said conductors being held in spaced relation with said supporting structure by said helical thread wrapping, and said tubular component forming a substantial air space midway between the conductors.

6. A cable for conducting high frequency electric

signals comprising an elongated hollow supporting structure of polyethylene, said supporting structure being formed with centrally disposed ribs which define a substantially central tubular passage between them, and a pair of conductors each having a thread of polyethylene wrapped thereabout in the form of a long-pitch helix, said thread-wrapped conductors being supported on said ribs on either side of said tubular passage, said conductors being held in spaced relation with the supporting structure by said helical thread wrapping, and said tubular passage forming a substantial air space midway between the conductors.

FIG. 1

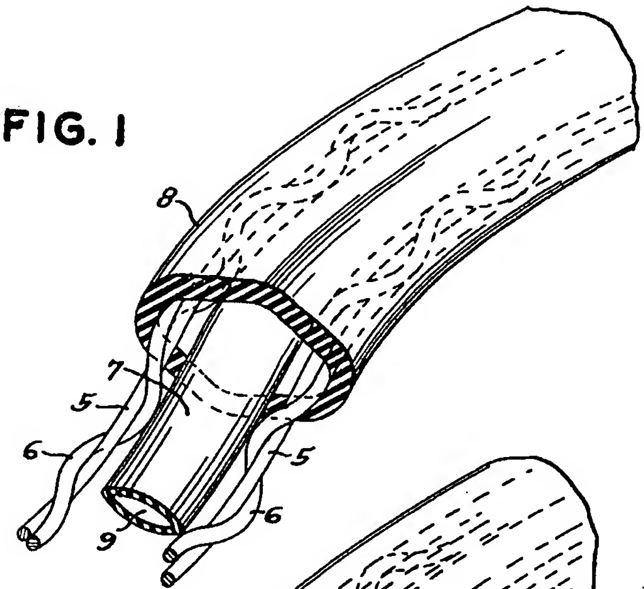


FIG. 2

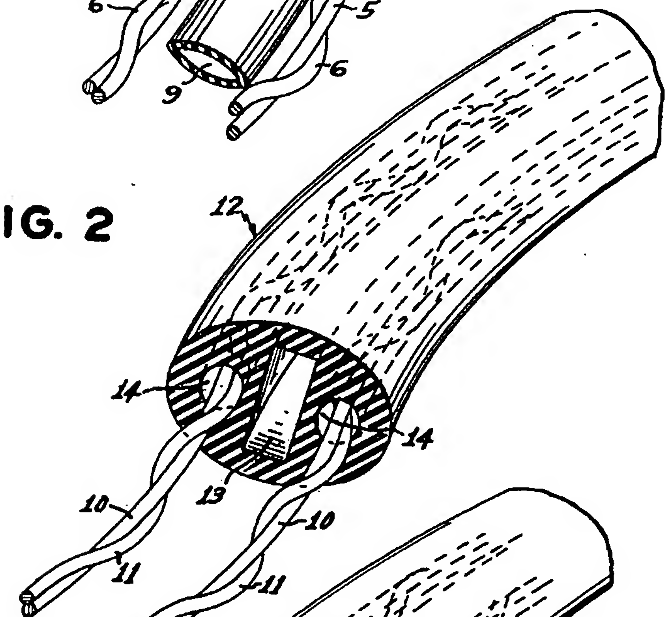
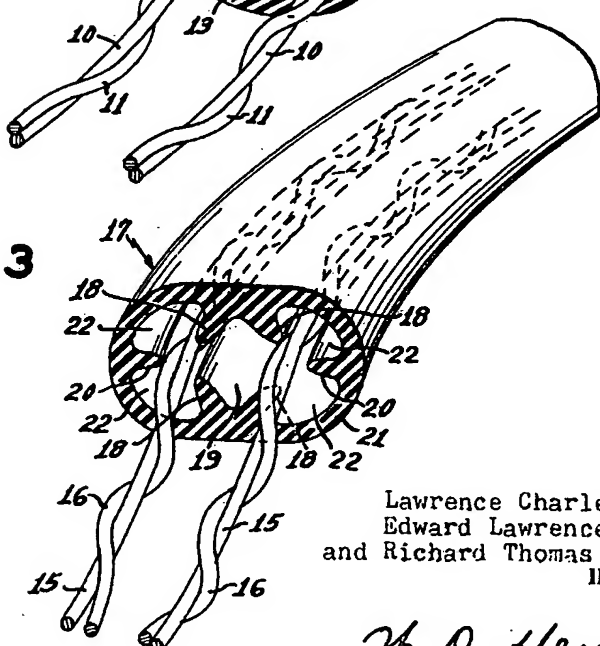


FIG. 3



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